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Taxonomy and Distribution of Japanese Populations of *Pyrus ussuriensis* Maxim. (Rosaceae)

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Wild and naturalized populations of *Pyrus ussuriensis* Maxim. are taxonomically re-investigated in Japan based on fresh materials and herbarium specimens. The species is newly circumscribed based exclusively on wild forms. It is characteristic in having leaves with the lamina less than 10 cm long, small fruits less than 3 cm long excluding the calyx and persistent calyx on the mature fruit. The species is divided into two varieties: var. *ussuriensis* and var. *hondoensis* (Nakai & Kikuchi) Rehder. Natural populations of *P. ussuriensis* are dispersedly distributed in Chubu and Northern Tohoku regions of Honshu. They grow in almost natural woodlands, but may hardly regenerate in wild. The present conditions may be endangered for *P. ussuriensis* var. *ussuriensis* and vulnerable for *P. ussuriensis* var. *hondoensis* in Japan. Conservation for the species should be necessary with its natural habitats.

Key words: conservation, distribution, population, *Pyrus*, taxonomy.

More than 50 species of pears of Japan had been described by Koidzumi (1915, etc.), and a few by Makino (1908, 1926) and Nakai (1918). Origins of these species were various; they were collected from natural wild populations, naturalized populations escaped from cultivated pears or cultivated wild pears that had been said to be collected from natural wild populations. Makino and Nemoto (1931) compiled them into 35 species including cultivated *Pyrus communis* L. and two Taiwanese species. However, Kikuchi (1943, 1946, 1948) recognized only four wild species in Japan, i. e., three species with five carpels: *P. aromatica* Kikuchi & Nakai, *P. hondoensis* Nakai & Kikuchi, and *P. serotina* Rehder, and one species with 2–3 carpels: *P. calleryana* Decne. Also, Ohwi (1953) selected the four as wild and distinct in Japan, but did not treat any names published by Koidzumi. Kitamura (1979) regarded many Koidzumi's species to identical with *P. pyrifolia* (Burm.f.) Nakai or *P. ussuriensis* Maxim., but most of the species were cited merely the names as synonyms without explanation for his recognition on the species. Three species with one variety and one natural hybrid have been recognized at present (Ohashi 1989, Iketani and Ohashi 2001). They are *P. calleryana* Decne., *P. pyrifolia* and *P. ussuriensis* with var. *hondoensis* (Nakai & Kikuchi) Rehder, and *P.* × *uyematsuana* Makino.

On the other hand, Kajiura and his coresearchers investigated diversity of Japanese pears (Kajiura et al. 1979, 1983, 1985, Kajiura and Suzuki 1980). They examined mainly old local cultivars of *Pyrus pyrifolia* and their related species. They found that many cultivated pears of their material from various localities resemble northern Tohoku wild pears (=*P. ussuriensis* Maxim. as *P. aromatica* Kikuchi & Nakai) or continental cultivars in China or Korea, which are referable to *P. ussuriensis* Maxim. or *P. bretschneideri* Rehd., than to the typical Japanese cultivars of *P. pyrifolia* in sugar content, fruit shape, flavonoids, and phenolic compounds. They deduced that such variation in the *P. pyrifolia* cultivars may have

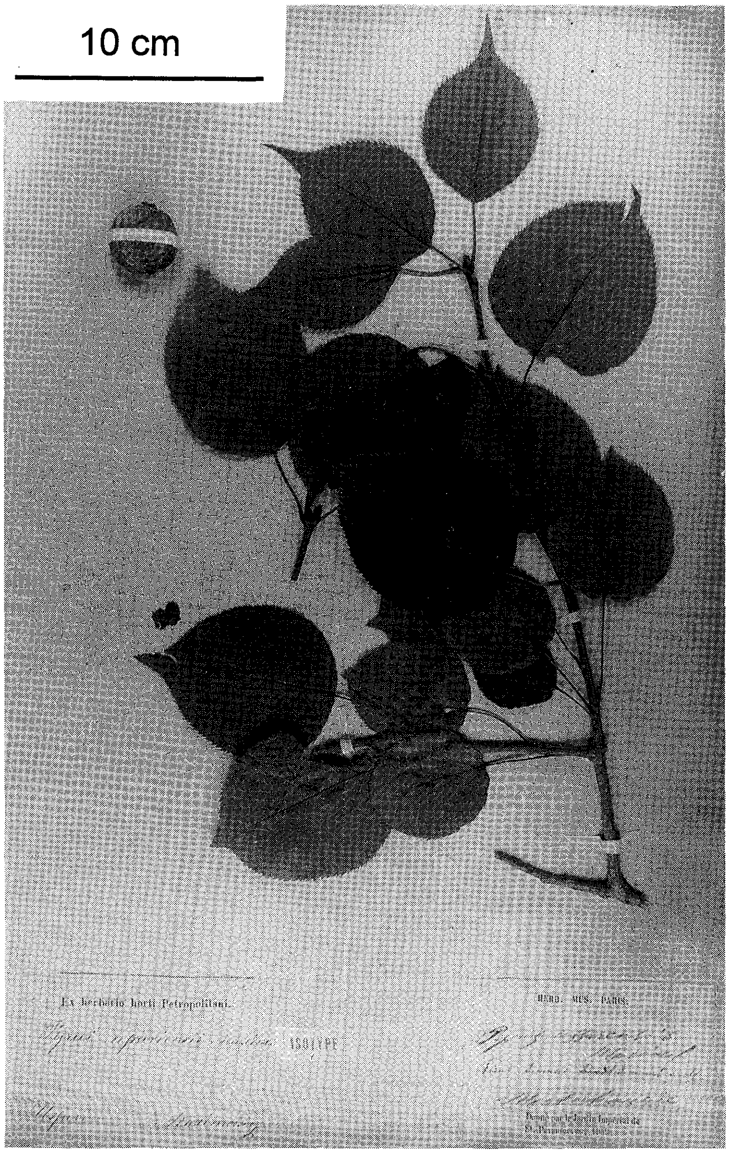


Fig. 1. *Pyrus ussuriensis* Maxim. Ussuri. Maximowicz s.n. (P, isotype).

been genetically influenced from either the northern Tohoku wild pears or introduced Chinese or Korean cultivars. Similar results for the Japanese pears were reported by analyses of the chloroplast DNA haplotypes (Iketani et al. 1998). These studies suggest that presumed hybridization or introgression between *P. pyrifolia* and *P. ussuriensis* may occur in Japanese *Pyrus* populations. Japanese populations of wild *Pyrus* species are, therefore, supposed to be a mixed complex composed of natural wild populations, naturalized cultivated trees and natural hybrids among the wild, naturalized and culti-

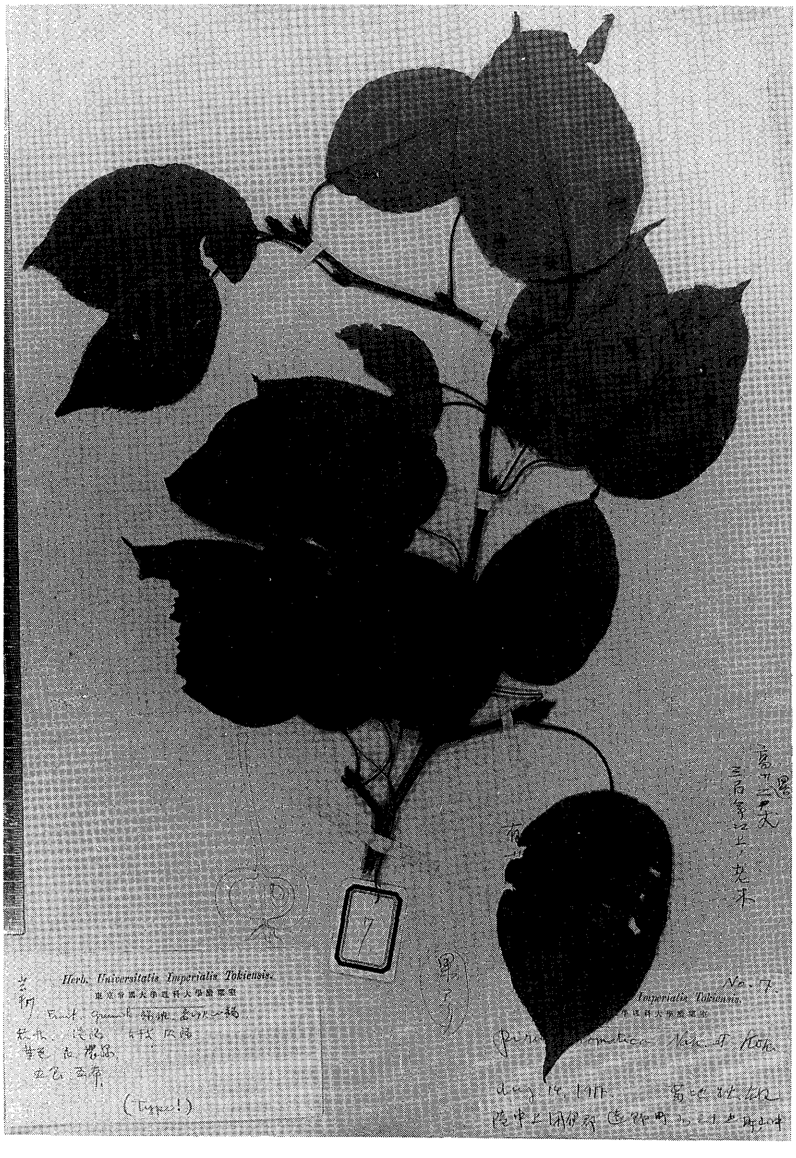


Fig. 2. *Pyrus aromatica* Kikuchi & Nakai. A. Kikuchi s.n., 14 Aug. 1917 (TI, syntype).

vated trees.

Through these studies no monographic works have so far been done for the Japanese *Pyrus*. The species have been treated only as a part of the flora of Japan. Hence, relations are ambiguous between the taxa previously published by Makino (1908, 1926), Koidzumi (1915, etc.) and Nakai (1918) and those species recognized in recent floras of Japan (Ohwi 1953, 1965a, 1965b, Kitamura 1979, Ohashi 1989, Iketani and Ohashi 2001).

In this paper, *Pyrus ussuriensis* Maxim. (Fig. 1) including *P. aromatica* Kikuchi & Nakai (Fig. 2) and *P. hondoensis* Nakai & Kikuchi (Fig. 3) is studied for its natural circumscription and taxonomic relations among them.

Materials and Methods

Populations of *Pyrus aromatica* Kikuchi & Nakai, *P. hondoensis* Nakai & Kikuchi, *P. ussuriensis* Maxim. and naturalized *Pyrus* are examined in the Tohoku District, Chubu District, Ussuri, China or Korean materials, and *P. ussuriensis* growing near human habitats in Japan, respectively. Field surveys were performed by Iketani in Iwate, Nagano, Yamanashi and Shizuoka Prefectures. However, natural populations of the wild *Pyrus* species, naturalized cultivars and local cultivars decreased greatly or were already extinct by developments of their habitats in many places, although observations of living populations in fields and in cultivation are needed for confirming their origin whether they were wild, naturalized or cultivated. Many populations were unfortunately not find in this study.

Herbarium specimens were examined in KYO, MAK, P, SHIN, TFA, TI, TNS and TUS. Many herbarium specimens, however, lack mature fruits even in the type which were characterized based mainly on the fruit character. The Koidzumi's types were examined in KYO and TI. They were included in *P. aromatica* or *P. hondoensis* as indicated in the specimens examined (Appendix 1) or excluded from *P. ussuriensis* (s. l.) by examination of the type and the original descriptions. Specimens collected by Iketani are preserved in TUS on which several characters were examined.

Morphological observation was emphasized on the following characters that have been described as important diagnostics in previous studies: leaf serration, lamina length, fruit length excluding calyx lobes (= 'fruit height' of Kajiura and Suzuki 1980), pedicel length and presence/absence of the calyx on mature fruits.

The lamina length was measured on the largest leaf of the short shoot. Fruit length was measured at least four fruits at maximum, minimum and mean values in fresh material. In case of herbarium specimens fruits were measured only the largest one that collected in or after September in avoiding premature fruits. In a preliminary test for examining relative size of fresh and dry fruits, mature fruits reduced to 84–89 % long and 83–87 % wide when dry. In some herbarium specimens including some type specimens with a drawing of fruit together with a vegetative shoot, data were taken from these drawings.

Results

1) Length of lamina and fruits (Fig. 4a)

The lamina of *Pyrus hondoensis* was often shorter than others (4.5–8 cm long). *Pyrus aromatica* had the lamina 6.5–9.5 cm long. *Pyrus ussuriensis* and naturalized *Pyrus* usually had larger laminas (more than 10 cm long). *Pyrus aromatica*, *P. hondoensis* and *P. ussuriensis* had small fruits, 1.5–3 cm long. Herbarium specimens of *P. aromatica* were also small in general. Cultivars of *P. ussuriensis* and naturalized *Pyrus* had larger fruits (3–10 cm long).

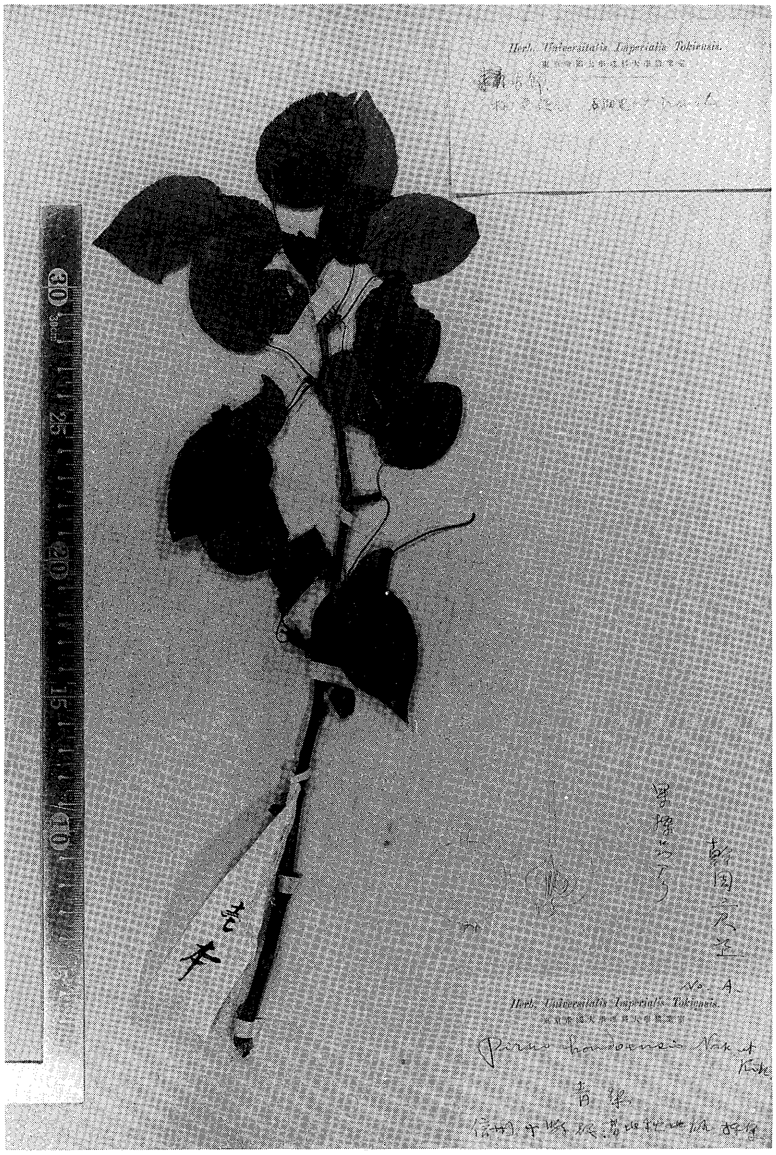
2) Pedicel length (Fig. 4b)

The pedicel varied from 0.5 cm to 6 cm

long, but *Pyrus hondoensis* had usually shorter pedicels (1.5–4 cm long). Kikuchi (1948) distinguished *P. aromatica*, *P. hondoensis*, *P. ussuriensis* and *P. pyrifolia* mainly by the pedicel length. However, they cannot be well distinguished by the character as shown in Fig. 4b.

3) Serration of the leaf (Fig. 5)

Pyrus aromatica and *P. ussuriensis* had setose-serrate leaves (Figs. 5a–c). *Pyrus hondoensis* varies rather widely in serration. Leaves of *P. hondoensis* usually were serrate or shortly setose-serrate (Figs. 5d–f), sometimes crenate (Figs. 5g, h). However, promi-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Herb. Universitatis Imperialis Tokiensis.
Herb. Universitatis Imperialis Tokiensis.
Pyrus hondoensis Nak. et Kik.

Fig. 3. *Pyrus hondoensis* Nakai & Kikuchi. Prov. Shinano. Chiisagata (as Ogata). A. Kikuchi No. A. (TI, syntype).

nently setose-serrate leaves were sometimes appeared on long shoots collected in autumn (Figs. 5k, l) and immature or young leaves in spring (Fig. 5j). Similarly, setose-serrate leaves were often observed on vegetative shoots without fruits in herbarium specimens.

4) Calyx lobe on mature fruits

In *Pyrus aromatica* and *P. hondoensis* the calyx lobes usually persistent on mature fruits, while the feature is variable in naturalized or cultivated *P. ussuriensis*. This feature has been adopted for *P. ussuriensis* (s. l.) distinguishing it from the other species in Japan, but sometimes it was known as doubious character. Now it becomes clear that it is useful for wild races, but variable in cultivated or naturalized ones.

5) *Pyrus aromatica* and *P. hondoensis*

As shown in Fig. 4a, *Pyrus ussuriensis*, *P. aromatica* and *P. hondoensis* are continuous in lamina and fruit length, although the latter has generally smaller in size. These facts indicate the species are conspecific.

Taxonomic treatment

Pyrus ussuriensis Maxim. is most variable among the Japanese *Pyrus*. The species was recognized first by Koidzumi (1915) as *P. ferruginea* Koidz. (=*P. rufoferruginea* Koidz.), but generally had been known as *P. aromatica* Kikuchi & Nakai. Nakai (1918) distinguished *P. aromatica* from *P. ussuriensis* by more tapering leaves, rufoferrugineous buds, white pilose young leaves and greenish fruits. Koidzumi (1919a, 1919b, 1924, 1925, 1929a, 1929b, 1930, 1932, 1934, 1935, 1936, 1937, 1939, 1941) had described a number of new species similar to *P. ussuriensis*, but most of them were con-

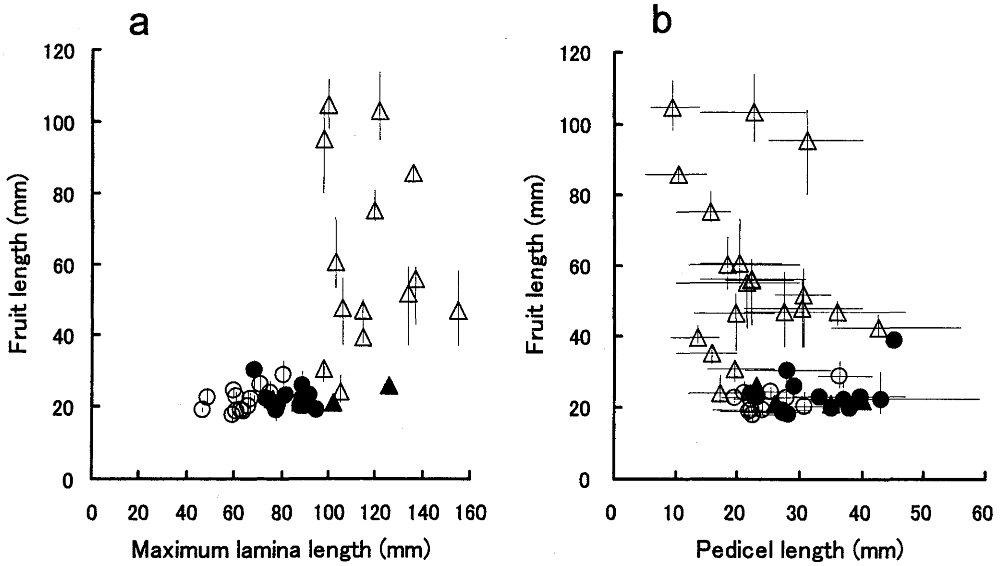

Fig. 4. Scatter diagrams showing relation between fruit length and maximum lamina length (a) and between fruit length and pedicel length (b) in the *Pyrus* species. ●: *P. aromatica*. ○: *P. hondoensis*. ▲: *P. ussuriensis* from the Asian Continent. △: Cultivars of *P. ussuriensis* and naturalized *Pyrus*. a: vertical lines shows the maximum and minimum values of the fruit length. b: maximum and minimum values are indicated with vertical lines (fruit length) and horizontal lines (pedicel length) in the living materials. Both in a and b, symbols without lines are data from herbarium specimens.

sidered as enitirely identical with *P. ussuriensis*, cultivated or naturalized forms of *P. ussuriensis* or hybrids between *P. ussuriensis* and *P. pyrifolia*. We did not give specific comments for each of the species which are regarded as identical with *P. ussuriensis* in this paper. Kikuchi (1948) characterized *P. aromatica* with persistent sepals on the fruit and long pedicels, while *P. ussuriensis* with persistent sepals and very short pedicels. These diagnostic characters are apparently within continuous range of variation in *P. ussuriensis*.

Pyrus hondoensis Nakai is similar to *P. aromatica*. Nakai (1918) distinguished it from the latter by smaller glabrous leaves, smaller serration, shorter pedicels and very small stone cells, and from *P. ussuriensis* by shorter caudate serration, more tapering leaves and greenish fruits.

Ohwi (1953, 1965a, 1965b) adopted *Pyrus aromatica* and *P. hondoensis* in 1953, but changed the former to *P. ussuriensis* var. *aromatica* and the latter to *P. ussuriensis* var. *hondoensis* in 1965. Kitamura (1979) treated 31 (–34) species including *P. hondoensis* as synonyms of *P. ussuriensis*. Ohashi (1989) and Iketani and Ohashi (2001) recognized *P. ussuriensis* var. *ussuriensis* and var. *hondoensis*.

We recognized that *P. ussuriensis* and its similar species are characteristic in having small leaves (less than 10 cm long in lamina) and small fruits (less than 3 cm long), and these were described from the Kitakami mountains in Iwate Prefecture, with an exception of *Pyrus amoena* Koidz. from Yamagata Prefecture. The type of *P. amoena* was collected from a cultivated tree and the tree is supposed to be introduced from Iwate Prefecture. We consider these are characteristic features of wild races of *P. ussuriensis*, not influenced genetically from cultivated trees.

On the contrary, species having large leaves (more than 10 cm long in lamina) and fruits (more than 4 cm long in longitudinal length) were also included among the synonymous of *P. ussuriensis* by Kitamura (1979). These were usually described based on cultivated trees or hybrids. Kitamura (1979) did not distinguish origin of the species he treated whether they come from wild, naturalized, cultivated or hybrid populations.

Pyrus ussuriensis Maxim. in Bull. Cl. Phys.-Math. Acad. Imp. Sci. Saint-Pétersb. **15**: 132 (1857) & Prim. Fl. Amur. 102 (1859); Rehder. in Proc. Am. Acad. Arts Sci. **50**: 227 (1915); Nakai, Fl. Syl. Korea. **6**: 49 (1916); Kitam. in Kitam. & Murata, Col. Ill. Woody Pl. Jap. **2**: 43 (1979), p. p.; H.Ohashi in Satake & al. ed., Wild Fl. Jap. Woody Pl. **1**: 227 (1989); Iketani & H.Ohashi in K.Iwats. & al. ed., Fl. Jap. **IIb**: 123 (2001).

Pyrus sinensis Decne. var. *ussuriensis* (Maxim.) Makino in Bot. Mag. Tokyo **22**: 69 (1908), p. p.; Makino & Nemoto, Fl. Jap. ed. 2, 479 (1931), p. p., ut *Pirus*.

Pyrus sinensis Decne., non Poir.: Koidz., Consp. Ros. Jap. 53 (1913).

var. **ussuriensis**.

Pyrus ferruginea Koidz. in Bot. Mag. Tokyo **29**: 158 (1915), non Hook.f. (1879).

Pyrus rufoferruginea Koidz. in Bot. Mag. Tokyo **29**: 311 (1915); Makino & Nemoto, Fl. Jap. ed. 2, 479 (1931).

Pyrus aromatica Kikuchi & Nakai in Bot. Mag. Tokyo **32**: 33 (1918); Makino & Nemoto, Fl. Jap. ed. 2, 475 (1931); Ohwi, Fl. Jap. 666 (1953), ut "Nakai & Kikuchi".

Pyrus amoena Koidz. in Bot. Mag. Tokyo **33**: 124 (1919); Makino & Nemoto, Fl. Jap. ed. 2, 475 (1931).

Pyrus insulsa Koidz. in Bot. Mag. Tokyo **33**: 127 (1919).

Pyrus jucunda Koidz. in Bot. Mag. Tokyo **33**: 128 (1919).

Pyrus nambuana Koidz. in Bot. Mag. Tokyo **33**: 128 (1919).

Pyrus obovoidea Koidz. in Bot. Mag. Tokyo **33**: 123 (1919).

Pyrus tremulans Koidz. in Bot. Mag. Tokyo **33**: 126 (1919).

Pyrus aromatica Kikuchi & Nakai var. *obovoidea* (Koidz.) Nakai in Bot. Mag. Tokyo **33**: 199 (1919); Makino & Nemoto, Fl. Jap. ed. 2, 475 (1931).

Pyrus rufoferruginea Koidz. var. *tremulans* (Koidz.) Nakai in Bot. Mag. Tokyo **33**: 201 (1919); Makino & Nemoto, Fl. Jap. ed. 2, 479 (1931).

Pyrus rufoferruginea Koidz. var. *aromatica* (Kikuchi & Nakai) Koidz. in Bot. Mag. Tokyo **38**: 91 (1924).

Pyrus rufoferruginea Koidz. var. *aromatica* (Kikuchi & Nakai) Koidz. subvar. *insulsa* (Koidz.) Koidz. in Bot. Mag. Tokyo **38**: 91 (1924).

Pyrus rufoferruginea Koidz. var. *aromatica* (Kikuchi & Nakai) Koidz. subvar. *tremulans* (Koidz.) Koidz. in Bot. Mag. Tokyo **38**: 91 (1924).

Pyrus yukinourana Koidz. in Acta Phytotax. Geobot. **4**: 158 (1935).

Pyrus oncocarpa Koidz. in Acta Phytotax. Geobot. **5**: 49 (1936).

Pyrus invicibilis Koidz. in Acta Phytotax. Geobot. **5**: 50 (1936).

Pyrus ussuriensis Maxim. var. *aromatica* (Kikuchi & Nakai) Ohwi, Fl. Jap. Engl. ed. 549 (1965), l. c. rev. ed. 776 (1965) ut var. *aromatica* (Nakai & Kikuchi) Rehder; Ohwi & Kitag., New Fl. Jap. rev. ed. 879 (1983), ut var. *aromatica* (Nakai & Kikuchi) Rehder.

Nom. Jap.: Michinoku-nashi (Koidzumi

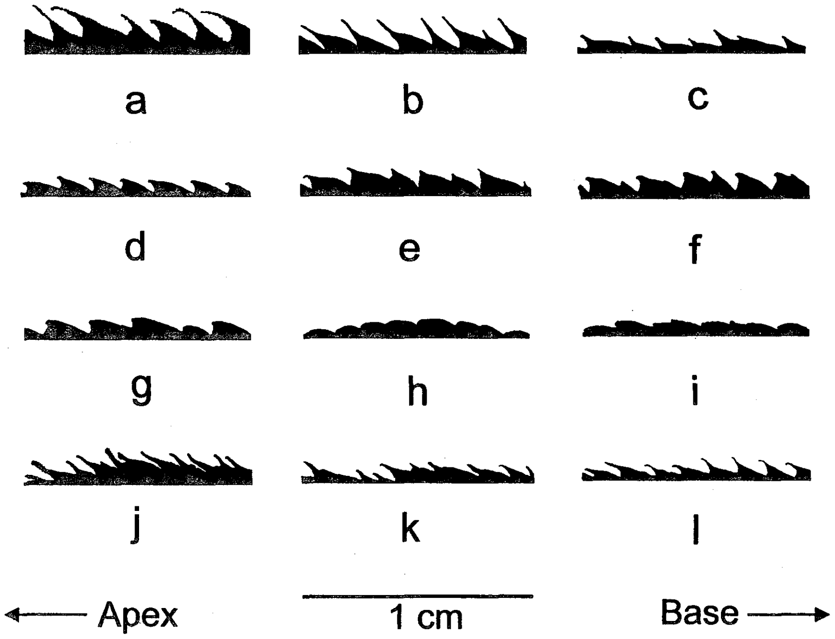

Fig. 5. Representative shape of leaf-teeth in *Pyrus ussuriensis* var. *ussuriensis* in Japan (b, c), var. *hondoensis* (d–l) and isotype of var. *ussuriensis* (a), Samples taken from the middle part of leaf-margin, a–i are leaves from a short shoot in autumn; j in spring; k and l from a long shoot in autumn. Voucher specimens: a: Maximowicz s.n. (P), b: Iketani 3479 (TUS), c: Iketani 3099 (TUS), d: Iketani 2916 (TUS), e: Iketani 2929 (TUS), f: Iketani 2906 (TUS), g: Iketani 2924 (TUS), h: Iketani 2907 (TUS), i: Iketani 2927 (TUS), j: Iketani 3490 (TUS), k: Iketani 2917 (TUS), l: Iketani 2718 (TUS).

1915), Iwate-yamanashi (Kikuchi and Nakai 1918).

Distribution: Japan [N. Honshu. Iwate Pref. alt. 500–1000 m. (Fig. 6a)], Ussuri, Korea and N. China.

Kitamura (1979) included 31 (–34) species as synonyms of *P. ussuriensis*, but of which 17 are excluded from the present species because those synonyms, which were all described by Koidzumi except for *P. crassipes*, seem to be hybrids between *P. ussuriensis* and cultivated races of *P. pyrifolia* (Burm.f.) Nakai and/or unknown forms probably derived from cultivated variants. They are *P. crassipes* Kikuchi & Nakai, *P. insueta* Koidz., *P. insularis* Koidz., *P. inutilis* Koidz., *P. iwatensis* Koidz., *P. koshiensis* Koidz., *P. kumaensis* Koidz., *P. kunoriana* Koidz., *P. leiostachya* Koidz., *P. longepedunculata* Koidz., *P. mayebarana* Koidz., *P. mikado* Koidz., *P. oblongolanceolata* Koidz., *P. squarrosa* Koidz., *P. ugoensis* Koidz., *P. wayamana* Koidz., *P. zenskeana* Koidz. Also, *Pyrus ovoidea* Rehder (=*P. ussuriensis* var. *ovoidea* (Rehd.) Rehd.), a species in China and Korea, is excluded from the synonymy. Among them the following seven were described from the Tohoku District: *P. crassipes*, *P. insueta*, *P. longipedunculata*, *P. iwatensis*, *P. wayamana*, *P. insularis*, and *P. ugoensis*. Their leaves and/or fruits are larger than those of *P. ussuriensis*. They were apparently cultivated trees.

Local cultivated trees with large fruits with small leaves were sometimes found in the Tohoku district. These may possibly be derived purely from wild *P. ussuriensis* populations. However, these cultivated races need further genetic confirmation. Hence those are excluded from the synonymy of *P. ussuriensis* in this study.

var. **hondoensis** (Nakai & Kikuchi) Rehder in J. Arn. Arb. **2**: 59 (1920), p. p., incl. basionym. cet. excl.; Rehder, Man. Cult. 405 (1927), l. c., ed. 2., 404 (1940) ; Kitam. in Kitam. & Murata, Col. Ill. Woody Pl. Jap. **2**: 44 (1979), ut syn. ?; Ohwi, Fl. Jap. Engl. ed. 549 (1965), l. c. rev. ed. 776 (1965); Ohwi & Kitag. New Fl. Jap. rev. ed. 879 (1983); H.Ohashi in Satake & al. ed., Wild Fl. Jap. Woody Pl. **1**: 227 (1989); Iketani & H.Ohashi in K.Iwats. & al. ed., Fl. Jap. **IIb**: 123 (2001).

Pyrus hondoensis Nakai & Kikuchi in Bot. Mag. Tokyo **32**: 34 (1918); Makino & Nemoto, Fl. Jap. ed. 2, 477 (1931); Ohwi, Fl. Jap. 666 (1953).

Pyrus hondoensis Nakai & Kikuchi var. *microphylla* Nakai & Kikuchi in Bot. Mag. Tokyo **33**: 199 (1919); Makino & Nemoto, Fl. Jap. ed. 2, 477 (1931).

Pyrus hondoensis Nakai & Kikuchi var. *lasiogyna* Nakai & Kikuchi in Bot. Mag. Tokyo **33**: 199 (1919); Makino & Nemoto, Fl. Jap. ed. 2, 477 (1931).

Nom. Jap.: Ao-nashi (Nakai and Kikuchi 1918).

Distribution: Endemic to Japan. Central Honshu: Yamanashi, Nagano and Gunma Prefectures, altitude 800–1600 m; probably extinct in Niigata, Kanagawa, Shizuoka and Gifu Prefectures. (Fig. 6b).

Nakai (1918) distinguished *Pyrus hondoensis* from *P. ussuriensis* by shortly caudate serration, more tapering leaves and greenish fruits, and from *P. aromatica* by smaller glabrous leaves, smaller serration, shorter pedicels and very small stone cells. Leaf serration, leaf size and pedicel length in *P. hondoensis* are reliable differences among them. Setose-serrate leaves are often found in several herbarium specimens perhaps collected from sprouting shoots without fruits. Fruits of wild pears are greenish then yellowish at mature stage. However, both green and brown fruits are observed in *P. aromatica*, as Kikuchi (1948) already mentioned. *Pyrus hondoensis* has always greenish fruits.

Pyrus hondoensis var. *microphylla* Nakai & Kikuchi was characterized as having small leaves (1–3 cm long), but is not distinguishable because it is merely a form described on the basis of a juvenile individual or a sprouting shoot of *P. hondoensis*. *Pyrus hondoensis var. lasiogyna* Nakai & Kikuchi, described as a form pilose at the base of styles, is also indistinguishable because the characteristics is perhaps a phenetic variation.

Kitamura (1979) included *Pyrus hondoensis* Nakai & Kikuchi as a synonym of *P. ussuriensis*. At the same time, however, he introduced this species as a variety of the latter in the additional note under *P. ussuriensis.* Although we judged that Kitamura recognized *P. hondoensis* as a distinct variety, he did not considered so but the species to be identical with *P. ussuriensis*. Kitamura (1979) noted that *P. hidaensis* Makino and *P. jintaroana* Koidz., both found in Gifu Prefecture, resemble *P. ussuriensis* var. *hondoensis* in having small leaves. They are also similar to var. *hondoensis* than to *P. pyrifolia* in obscurely setose-serrate leaves. They differ from them, however, in having long pedicels. They may be derived from cultivated forms of *P. ussuriensis* var. *hondoensis*, but further confirmation is necessary to determine identity of these species. There are old herbarium specimens of *P. ussuriensis* var. *hondoensis* in Gifu Prefecture (Fig. 6b).

Pyrus mikawana Koidz. (in Bot. Mag. Tokyo **39**: 19, 1925) was also regarded to be similar to *P. ussuriensis* var. *hondoensis* by Kitamura (1979), but is perhaps a hybrid between *P. pyrifolia* or *P. ussuriensis* and *P. calleryana* Decne., because it has 3–5 styles.

Distribution in Japan

The present area of *Pyrus ussuriensis* var. *ussuriensis* is limited mainly to Kitakami mountains in Iwate Prefecture (Fig. 6a). Northern regions of the area were confirmed as native in genetic resource explorations (Katayama et al. 2001, Yoneyama and Makita 2001). The present distribution of *P. ussuriensis* var. *hondoensis* is limited to Mts. Yatsugatake (represented by Mt. Akadake in Fig. 6b) and west Kanto mountains, but many specimens of the variety were collected in different localities peripheral to the Yatsugatake-Kanto mountains area, e. g., Mts. Myoko and Mt. Togakushi in the North, Mts. Hakone and Mt. Fuji in the south, Mt. Ena-san and Mts. Ontake in the west. The type localities of *P. hondoensis* are not included in the Yatsugatake-Kanto mountains area. They are Mt. Fuji and Chiisagata (erroneously as “Ogata” in the original publication) (Nakai 1918). Comparing the present distribution area of var. *hondoensis* with an area outlined from specimens, the former is distinctly narrower than the past. Populations represented by the old herbarium specimens are not certain whether they are still exist in the localities of the specimens or not. There is a report on populations at the type localities of *P. hondoensis* by Matsuyama (1930).

The disjunctive distribution pattern between the Kitakami mountains and the Chubu district is already known in several same or closely related plants (Ohashi 1987). Distribution of *P. ussuriensis* is an additional example for this pattern.

Pyrus ussuriensis var. *ussuriensis* and var. *hondoensis* grow in upper mountainous areas, where human settlements were rare until the 19th century. There were two Cenozoic fossil species of *Pyrus* in Japan. *Pyrus hokiensis* Ozaki found from the late Miocene series in Tottori Pref. (Ozaki 1980). *Pyrus pyrifolia* is reported from Pleistocene Shiobara flora in Tochigi Prefecture (Onoe 1989). Both fossils may be referable to *P. ussuriensis* (s. l.) in having small leaves of which the lamina 2.5–7 cm long (Voucher specimens: NSM PP 16165–16170 in the National Science Museum. SFPG 80 in The Shiobara Fossil Plant Garden). The area of

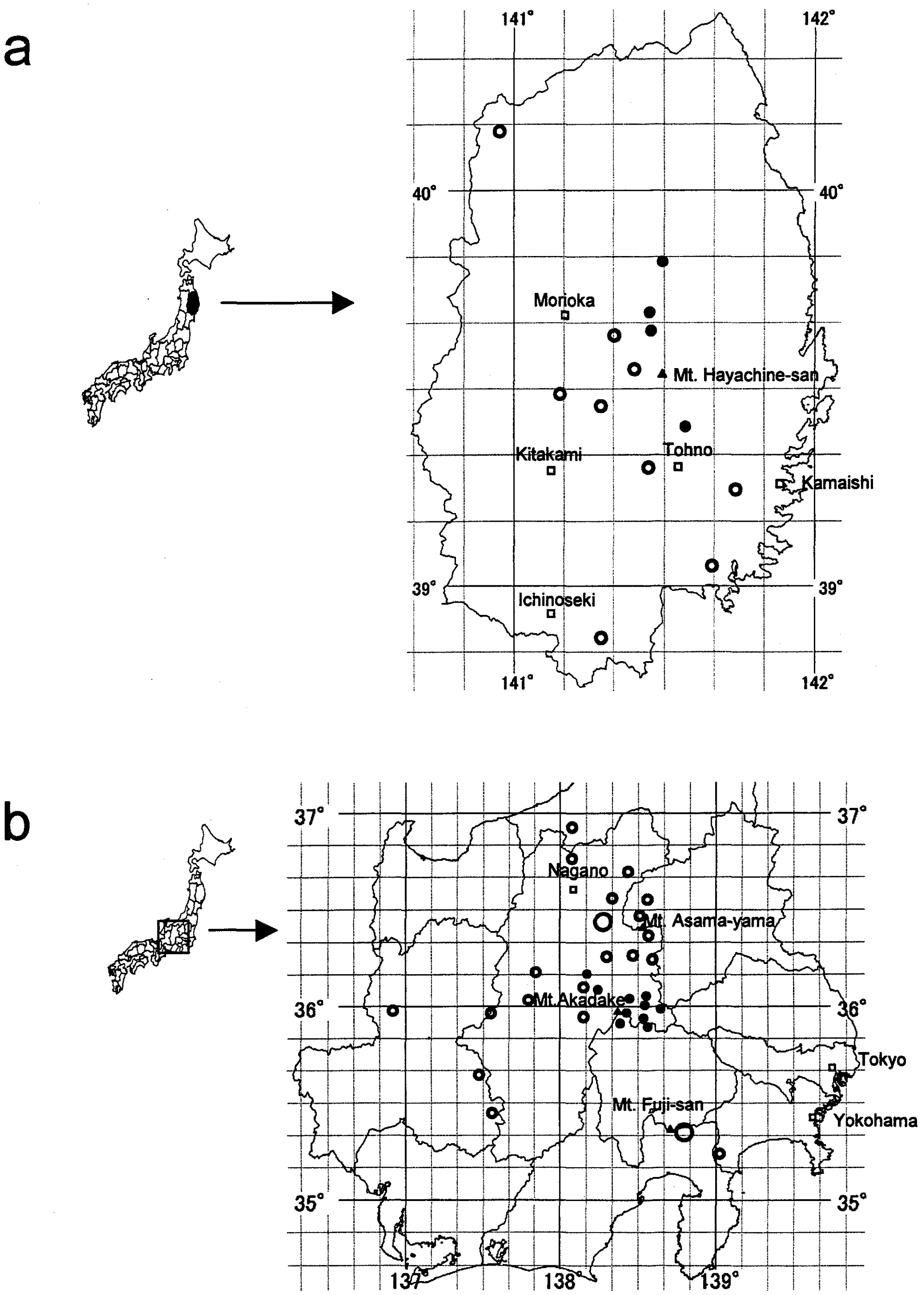

Fig. 6. Distribution maps of *Pyrus ussuriensis* in Japan. a: var. *ussuriensis*. b: var. *hondoensis*. Closed circles show localities of living trees; Open circles herbarium specimens. Large open circles are the type localities of *P. hondoensis*.

P. ussuriensis seems to be broader in the past than at the present in Japan.

Conservation problems of *Pyrus ussuriensis* in Japan

According to Nakai (1918), "many big trees (=*Pyrus ussuriensis* var. *ussuriensis*, as *P. aromatica* Kikuchi & Nakai) are in above cited localities where they are undoubtedly wild. We counted the number of the annual rings of several cut down trees and could ascertain that they are more than three haundred years old." Kikuchi and Takeuchi (1919) reported both *P. ussuriensis* var. *ussuriensis* and var. *hondoensis* (as *Pyrus aromatica* and *P. hondoensis*) grew wild and collectively at the time of discovery. However, the habitats now become completely different. *Pyrus ussuriensis* var. *ussuriensis* trees survived only scatteringly in pastures. No juvenile trees were found. The observations of Katayama et al. (2001) and Yoneyama and Makita (2001) were described similar situation.

The circumstance in *Pyrus ussuriensis* var. *hondoensis* is slightly promising. Not a few trees of the pear are found in forests. They now grow in secondary forests derived from primary forests of *Quercus crispula* Blume of which exploitation was made mainly after the Second World War. In addition, some trees grow on damp habitat, where juvenile trees are sometimes found.

However, the future of habitat is not so hopeful. The center of present distribution area, in altitude 800–1600 m in the Yatsugatake mountains, is one of the most exploited places for leisure purposes and upland agriculture. In the area under 1300 m altitude, trees are found only within areas of human habitation, that is, roadside, boundary of crop fields, precincts of shrines, etc. Even in higher areas, many native habitats have been transformed into summerhouse sites or golf courses.

The present conditions may be endangered for *Pyrus ussuriensis* var. *ussuriensis* and vulnerable for *P. ussuriensis* var. *hondoensis* in Japan with the criteria of the Environment Agency of Japan (2000). Conservation should be necessary on these plants with their natural habitats.

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Appendix 1. Voucher and representative specimens examined. Specimen numbers after Iketani indicate that those specimens were collected from the same tree, although they were collected in different times. Voucher specimens used for measurement are designated with an asterisk (*).

***Pyrus ussuriensis* Maxim. in Japan**:

Iwate Pref.: Tamayama-mura: Hayasaka-kogen (Iketani 3025, 3102 & 3481*, TUS; Iketani 3026, 3102 & 3480*, TUS; Iketani 3479, TUS). Kawai-mura: Matsukusa (Iketani 3021, 3096 & 3482*, TUS; Iketani 3022, 3097 & 3478*, TUS). Iwaizumi-cho: Yomogihara (Iketani 3023 & 3098, TUS; Iketani 3099 & 3475*, TUS), Hitutori (Iketani 3024 & 3100, TUS). Ashiro-cho: Tayama (Toba 128, KYO). Morioka-shi: Kuzakai (Yukinoura s. n., 23 Oct. 1935*, syntype of *P. invicibilis*, KYO; Yukinoura 10*, KYO; Yukinoura s. n., 24 Oct. 1935*, KYO; Yukinoura s. n., 5 Aug. 1934*, KYO; Yukinoura 8*, syntype of *P. oncocarpa*, KYO), Yanagawa (Yukinoura s. n., 5 Aug. 1934*, syntype of *P. yukinourana*, KYO). Tohno-shi: Arakawa-bokujo (Iketani 3029 & 3109*,TUS), Ayaori (Kikuchi s. n., 15 Aug. 1917*, syntype of *P. aromatica*, TI; Koidzumi 135*, TI), Obatano (Koidzumi 41*, cultivated, syntype of *P. obovoidea*, KYO; Date & collector unknown, syntype (?) of *P. obovoidea*, TI), (Kikuchi s. n., 14 Aug. 1917*, syntype of *P. aromatica*, TI). Ohasama-machi: Uchikawame (Collector unknown, 17 Oct. 1918*, TI; Koidzumi s. n., July 1914, Holotype (?) of *P. ferruginea*, TI), Dake (Koidzumi 55, cultivated, syntype of *P. tremulans*, KYO; Date & collector unknown*, syntype (?) of *P. tremulans*, TI), Ohmata (Ohshida, s. n., 16 Oct. 1918, syntype of *P. nambuana*, KYO; Ohshida s. n., date unknown*, syntype (?) of *P. nambuana*, TI), Ohmata–Nakanokai (Koidzumi 59, syntype of *P. insulsa*, KYO; Date & collector unknown, syntype (?) of *P. insulsa*, TI), Oide (Muroi s. n., 20 July 1936*, KYO), (Koidzumi 36, cultivated, syntype of *P. jucunda*, KYO). Ishidoriya-cho: (Koidzumi 35*, cultivated, syntype of *P. jucunda*, KYO; Date & collector unknown, syntype (?) of *P. jucunda*, TI). Kawasaki-mura: Usuginu (Toba 139, KYO). Kamaishi-shi: Kasshi (Sasamura 172, KYO). Rikuzentakada-shi: Higami-san (Uyama 980273 & 980274, TUS).

Yamagata Pref.: O'e-machi: Shichiken (Koidzumi 27, cultivated, syntype of *P. amoena*, KYO).

***Pyrus ussuriensis* from the Asian Continent:**

RUSSIA. Ussuri (Maximowicz, s.n., date unknown, Isotype, P).

KOREA. Kyonggido: (Nakai 2298, TI). Kyongsangnamdo: Chi'i-san (Okamoto 16885, KYO; Okamoto s. n., 3 Sept. 1934, KYO). Chollapukdo: Mantok-san (Chang s. n., 15 Sept. 1940, KYO).

Pyrus ussuriensis* var. *hondoensis:

Gifu Pref.: Ena-san (Yato s. n., 7 Aug. 1930, KYO). Kawakami-mura: (Umemura s. n., date unknown, KYO). Takasu-mura: Kittate (Shioda s. n., 6 July 1933, KYO)

Gunma Pref.: Naganohara-machi: Naganohara (Masuda 5578, KYO), Kitakaruizawa (Masuda 7103, MAK 318031). Tsumagoi-mura: Kanbara (Masuda 7505, MAK318032).

Kanagawa Pref.: Hakone (Makino s. n., May 1919, MAK 213963; T. Makino s. n., in 1922, MAK 213964).

Nagano Pref.: Chiisagata [as Ogata in the original description] (Kikuchi no.A, syntype of *P. hondoensis*, TI). Shiga-kogen (Kato s. n., July 1962, MAK 278555). Togakushi-mura: Koshimizugahara (Wada 116, SHIN; Ohkawa s. n., 1 Aug. 1960, TNS 604366). Sanada-machi: Sugadaira (Shimizu 18986, SHIN; Murata & Koyama 77, KYO), Handayama (Yamagishi s. n., 23 May 1918, syntype of *P. hondoensis* var. *lasiogyna*, TI). Karuizawa-machi: Mimamikaruizawa (Hurusawa s. n., 15 July 1950, TI). Saku-shi: Uchiyama-toge (Ikeda s. n., 17 June 1981, SHIN), Arafune-yama (Matsuda 8–144, SHIN 0183992), Hirao-yama (Ikeda s. n., 8 Aug. 1984, SHIN 117731), Tatami-ishi (Ikeda s. n., 17 June 1981, SHIN). Mochizuki-machi: Kyowa (Takahashi s. n., 29 Oct. 1921, MAK 213968). Nagato-machi: (Iketani 3487, TUS). Fujimi-machi: Nyugasa-yama (Imai s. n., 15 Aug. 1964, SHIN 171032). Yamagata-mura: Shimizu-Kogen (Kiyosawa H0380, SHIN 73367). Nagato-machi: Himenokidaira (Mochizuki s. n., 02 Aug. 1979, SHIN 156972). Kawakami-mura: Hara (Iketani 2762 & 2927*, TUS; Iketani 2780 & 2928*, TUS), Azusayama (Iketani 2713, 2763 & 2929*, TUS; Iketani 2717, TUS), Hisawa (Iketani 2769 & 2907*, TUS), Hara–Shinshu-toge (Iketani 2778 & 2926, TUS; Iketani 2779, TUS). Minamimaki-mura: Shishi-iwa (Iketani 2720, 2766, 2789 & 2910*, TUS; Iketani 2878 & 2908*, TUS; Iketani 2909*, TUS; Iketani 2911, TUS; Iketani 2788*, TUS; Iketani 2913*, TUS), Uminokuchi (Iketani 2770 & 2906, TUS), Otoko-yama (Yamazaki s. n., 24 Sept. 1984, SHIN 94709). Kitaaiki-mura: foot of Oyasawa-toge (Iketani 2771 & 3490, TUS; Iketani 3491, TUS), Ama-ike (Takei s. n., 06 Aug. 1973, SHIN 124283). Koumi-machi: Oyasawa (Iketani 2772, TUS). Suwa-shi: Kirigamine (Imai s. n., 7 July 1979, SHIN). Shimosuwa-machi: Kannon-zawa (Imai s. n., 25 Sept. 1966, SHIN 171028). Chino-shi: Tateshina (Iketani 2768, TUS), Shirakaba-ko (Iketani 2721 & 2918*, TUS; Iketani 3489, TUS). Narakawamura: Takatoh-wan (Matsuda s. n., 27 June 1993, SHIN 152999). Kaida-mura: Nishino-hondani (Okuhara s. n., 17 June 1964, SHIN 118089).

Niigata Pref.: Myoko (Makino s. n., in 1934, MAK 213966).

Shizuoka Pref.: Fuji, Ipponmatsu (present Gotenbashi) (Kikuchi nos. 3 & 4, syntype of *P. hondoensis* var. *microphylla*, TI). Fuji-san (Makino s. n., 13 May 1917, MAK 213972).

Yamanashi Pref.: Oizumi-mura: (Iketani 2781 & 2916*, TUS; Iketani 2782 & 2917*, TUS; Iketani 2764, TUS; Iketani 2719, 2783 & 2915, TUS; Iketani 3492, TUS). Takane-cho: Gakko-ryo (Iketani 2718 & 2765, TUS; Iketani 2784 & 2914, TUS; Iketani 2875, TUS; Iketani 2786, TUS). Sudama-cho: Tenshi-en (Iketani 2774, TUS), Kuromori (Iketani 2721, 2760 & 2925 TUS; Iketani 2924*, TUS), Shinshu-toge (Iketani 2762, 2777*, TUS), Kanayama (Iketani 3495, TUS). Fuji-san (Makino s. n., in 1920 MAK 225825).

Appendix 2. Cultivated material and voucher specimens examined. For cultivated trees, cultivar or strain names and the accession number (JP number) of Genebank of the Ministry of Agriculture, Forestry and Fisheries were indicated. Voucher specimens were collected by Iketani, which are indicated with a herbarium acronym.

Chinese and Korean cultivars of *Pyrus ussurienesis*:

Cultivars having the names appeared in Yü (1979) as those belonging to *Pyrus ussuriensis* and local races were selected.

'Nan-guo-li' (JP 115732; Iketani 2743, TUS). 'Hwang-sil-li' (JP 114748). 'Hoe-ryng Saibai' (JP 113729). 'Jian-ba-li' (JP 113745). 'Ba-li-xiang' (JP 113749). 'Su-hyang-li' (JP 113738). 'Manchuria wild' (JP 113821; Iketani 2589, TUS).

***Pyrus ussuriensis* naturalized or cultivated in Japan:**

Trees of *Pyrus ussuriensis* that are presumably naturalized and colleted from areas near human habitation in eastern Japan or regions of the Sea of Japan were selected. Only the trees that bear the fruits with a persistent calyx (at least in 70 % of fruits) were selected.

'Iwate yamanashi' (JP 113527; Iketani 2493, 2520 & 2558, TUS). 'Akita yamanashi 2' (JP 113790; Iketani 2594, TUS). 'Akita tazawa 1' (JP 113787). 'Akita tazawa 3' (JP 113789; Iketani 2593, TUS). 'Iwate 1' (JP 113795; Iketani 2608, TUS). 'Iwate 2' (JP 113796; Iketani 2610, TUS). 'Iwate 5' (JP 113799). 'Iwate 6' (JP 113800). 'Ideyamanashi' (JP 113793). 'Shimane yamanashi' (JP 113810). 'Shoumyouji nashi' (no JP number). 'Nagano 7' (JP 113803; Iketani 2605, TUS). 'Shimoina 1' (JP 113811; Iketani 2604, TUS). 'Choukai A' (JP 113791). 'Choukai B' (JP 113792).

池谷祐幸，大橋広好：**日本産ミチノクナシの分類と分布**

日本に野生するナシ属は50種以上が記録されており，特に小泉（1915など）によって多数の新種が記載された．しかし，菊池（1943, 1946, 1948）はこれら多数の新種にとらわれず，5心皮をもつイワテヤマナシ，アオナシ，ニホンヤマナシおよび2–3心室のマメナシの4種を日本の野生種と認めた．大井（1953）も菊池と同じ4種だけを認めた．イワテヤマナシ，アオナシ，ヤマナシ，マメナシである．後にアオナシをイワテヤマナシの変種とし，3種1変種とした（Ohwi 1965a, 1965b）．北村（1979）の扱いではミチノクナシ（= イワテヤマナシ），マメナシ，ヤマナシと2雑種が認められているようにみえる．さらに大橋（1989），Iketani and Ohashi (2001) では，ミチノクナシと変種アオナシ，マメナシ，ヤマナシおよびマメナシとヤマナシの自然雑種アイナシの3種1変種1雑種が認められている．

一方，梶浦ら（1979, 1983, 1985）や梶浦・鈴木（1980）は日本における在来の栽培ナシ（ヤマナシの明治以前の栽培品種）の地理的変異を詳細に調べ，東北や日本海側で栽培されていた品種では大陸の栽培品種やイワテヤマナシに類似する形態や化学成分を持つものが多いことを明らかにした．また，Iketani et al. (1998) は在来の栽培ナシとその野生状個体にはイワテヤマナシやアオナシを含むミチノクナシの遺伝的影響を受けたものが少なくないことを示した．これらの結果からミチノクナシと栽培ナシとの間に雑種のあることおよびミチノクナシに由来する栽培品のあることという可能性が推定される．

しかし，日本のナシ属は大井（1953, 1965a, 1965b）以後の諸見解では，植物誌や図鑑の一部として結果だけが示される形で発表されてきた．菊池（1943, 1946, 1948）は日本のナシを広く研究したが，以前に記載されていた多数の種について個々の分類学的な検討結果を発表しなかった．北村（1979）だけが小泉の種を異名に挙げているが，全部ではなく，また異名とした理由も一部を

除き示されていない．このため，それより前に記載された多数の種との関係が分かりにくくなっている．しかしながら，近年の開発によって日本のナシ属植物の野生種集団は減少し，栽培個体あるいは栽培品から逸出して野生化した集団は絶滅したものが多い．このため，新しい研究材料を得ることの困難さがナシ属再検討の障害となっている．小泉の記載した多数の種の再検討は残されたおしば標本と簡単な記述だけに頼らざるを得なくなった．日本のナシ属の分類は不完全のままとなっているのが現状である．

本論文では日本のミチノクナシについての研究をまとめた．ロシア，中国，朝鮮にも *Pyrus ussuriensis* Maxim. の同種とみられる種があるが，ここでは日本国内から記載された種について検討する．本種は日本では長くイワテヤマナシ（Nakai 1918）と呼ばれ，*P. aromatica* Kikuchi & Nakai という学名に当てられていた．ミチノクナシは小泉（1915）が *P. ferruginea* Koidz. につけた和名であるが，この種が *P. ussuriensis* の異名となったため，既に *P. ussuriensis* につけられていたチョウセンヤマナシあるいはチュウゴクナシに代えて北村が採用した．

北村（1979，43ページ）はミチノクナシ *Pyrus ussuriensis* の下に主に小泉によって記載された31種の学名を異名として引用した．この扱いについて北村は「ミチノクナシは多くの小さい変異があり，それはおそらく遺伝するのであろうが，ほとんど栽培または逸出と思われる植物であることから，大きくまとめて取り扱った」とした（同44ページ）．北村の扱いには分かりにくいところがあり，ミチノクナシの異名とした *P. hondoensis* Nakai & Kikuchi を変種アオナシ var. *hondoensis*（Nakai & Kikuchi）Rehder としても扱っていたり（同44ページ），*P. insueta* Koidz. と *P. oncocarpa* Koidz. はミチノクナシから区別しているようにも読める（同44ページ）．また，*P. hidaensis* Makino, *P. jintaroana* Koidz. および *P. mikawana* Koidz. の3種についても，多分ミチノクナシと同種として扱っているようにみえる（同44ページ）．もし，この3種も含めると，北村は34種をミチノクナシと同種として認めたように思われる．

しかし，北村（1979）がミチノクナシの異名とした種の中には野生集団から記載されたものと栽培品，野生化品からのものが含まれており，後者は厳密なミチノクナシと判定できず，また，その他正体不明のものが含まれていることが分かったので，17種を除外した．本研究の結果から，栽培化の影響を受けていない野生ミチノクナシは小形の葉（葉身は長さ10 cm以下）と果実（長さ3 cm以下もの）をもつことが特色であることが明らかとなった．また，葉ないし果実の大きい種は栽培または栽培からの野生化品と見なした．

アオナシは基本的にはミチノクナシと一致するが，それと比較すると，葉身が短く（アオナシでは最大でも長さ8 cm程度），葉柄長も1–3 cmでより短いこと，および葉縁の芒が不明瞭で単鋸歯になること（ミチノクナシでは芒状鋸歯縁）で異なっている．したがって，アオナシはミチノクナシの変種とするのが妥当であると思われる．

日本産のミチノクナシは発表時には群落をなし，明らかな野生であると記録されている（Nakai 1918）．またアオナシについては高木で周囲2フィート以上あると記述されている（Nakai 1918）．北村（1979，43ページ）は大陸から伝来した可能性を疑っているが，野生集団を区別して認識していなかったためと思われる．これらの自生地は垂直分布ではともに温帯上部であり，古代より人間活動の影響が少なく，人の定住は以前にはほとんどなかったと思われる地域である．したがって，特定の地域に分布すること，その生育状態，および形態的に小形であることから，日本のミチノクナシは自生品であると考えられる．

イワテヤマナシの現在の確実な分布域は北上山地に限られる．しかし人家の近くや牧場内などに単木的に残存するにすぎない．若木は見あたらずもはや天然には更新できていないように思われる．

アオナシの現在の分布域は八ヶ岳周辺および関東山地の西側にほぼ限られるが，標本記録では少なくとも過去にはさらにその周辺部にも分布していた．アオナシは現状ではイワテヤマナシよりもやや密に存在し，ミズナラ林を伐開した二次林内や湿性地といったより天然の立地に近いところに生育している．しかし現場はリゾート地帯であるため，少なからぬ個体の自生地が別荘地やゴルフ場となっている．人的環境が近くに迫ったことにより栽培のナシからの遺伝的汚染も避けがたいと思われる．現存個体には大木が多く1世代も長いので当分絶滅の危険性は少ないかもしれないが，世代の更新には難しい状況にあると思われる．

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